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Superfluidity in a Strongly Interacting Polarized Fermi Gas

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Cooper pairing is the underlying mechanism for the Bardeen-Cooper-Schrieffer superfluid state of equal mixture of two fermionic components. An interesting situation arises when the symmetry between the two components is broken, such as mass, density, or chemical potential. Is the pairing mechanism robust enough to overcome an asymmetric stress and keep driving superfluidity? Does a new form of superfluidity emerge out of two mismatched Fermi seas? We experimentally study these questions in an unequal mixture of strongly interacting ultracold fermionic atoms trapped in a three dimensional harmonic potential. We observe that due to strong interaction, the system maintains superfluidity up to a critical population imbalance, showing Pauli limit of superfluidity [1]. By correlating condensation fraction and in-situ density distribution, we identify that a superfluid has equal densities of two components and spatially separates from a normal gas of unequal densities [2]. Recent experimental results will be discussed. [1] M.W. Zwierlein et al., Science 311, 492 (2006). [2] Y. Shin et al., Phys. Rev. Lett 97, 030401 (2006).